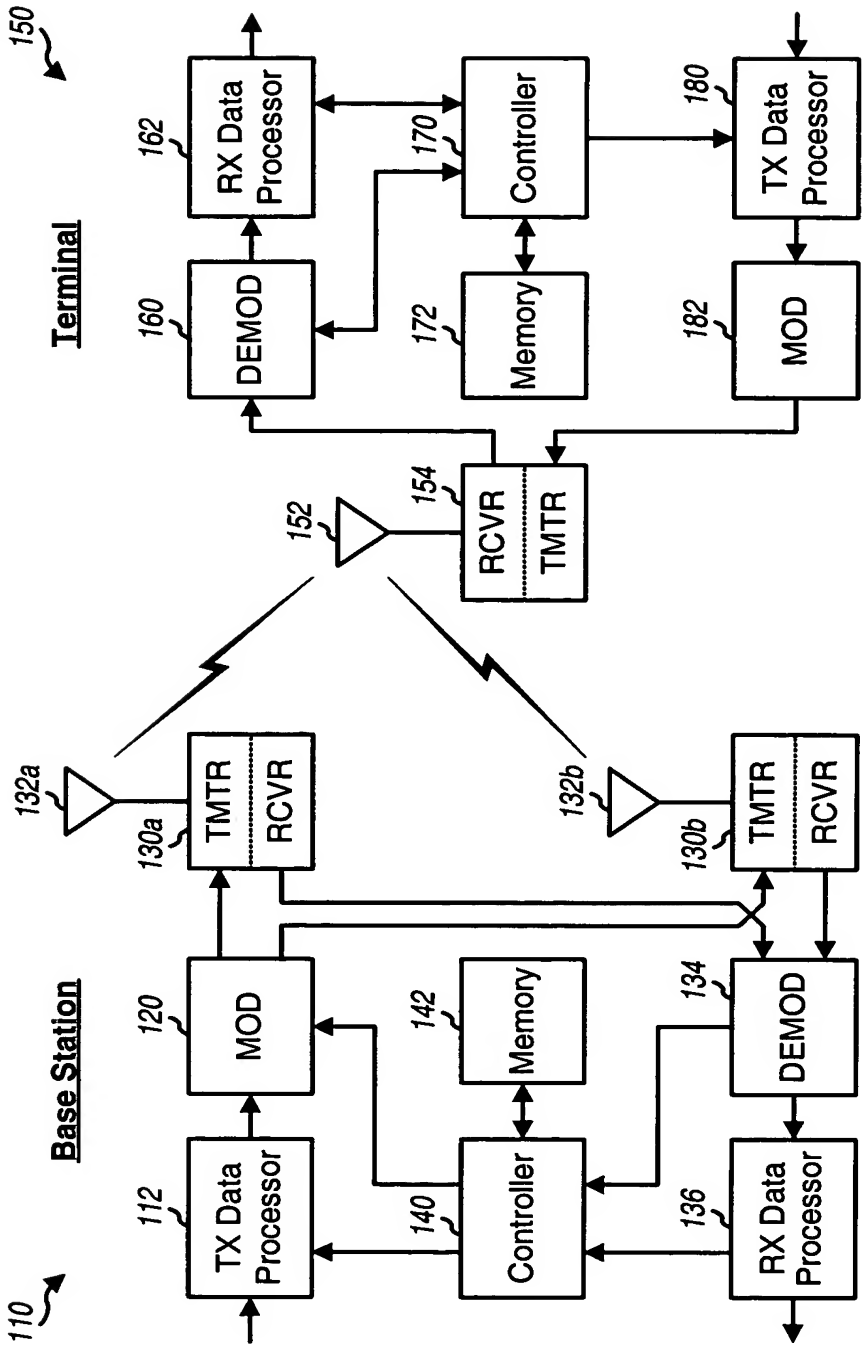
150
Terminal
162
RX Data Processor
170
Controller
180
TX Data Processor
160
DEMOD
172
Memory
182
MOD
154
RCVR
TMTR
152
132a
130a
TMTR
RCVR
132b
130b
TMTR
RCVR
Base Station
120
MOD
142
Memory
134
DEMOD
110
112
TX Data Processor
140
Controller
136
RX Data Processor

FIG. 1

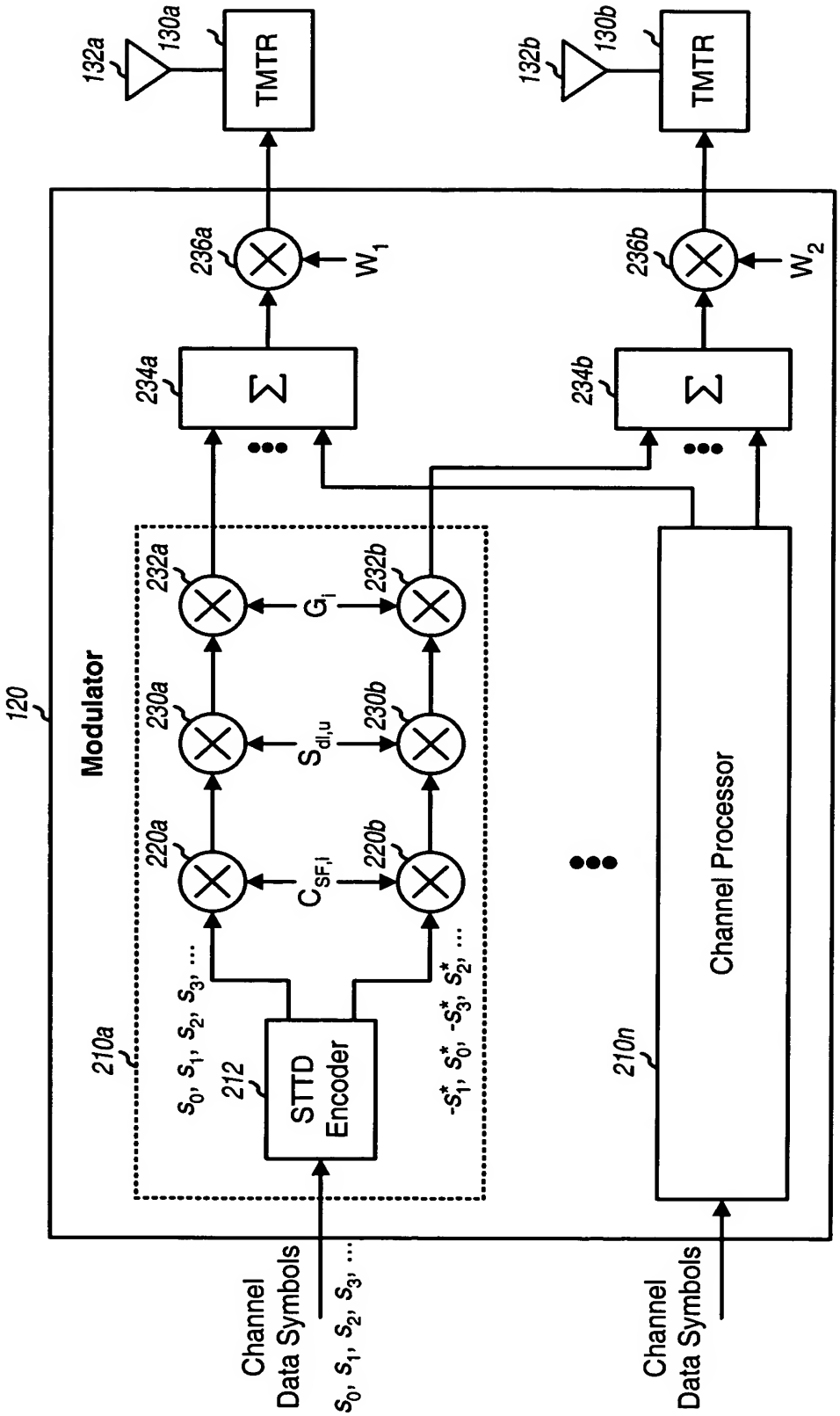
120
Modulator
210a
210n
212
STTD Encoder
220a
220b
230a
230b
232a
232b
234a
234b
236a
236b
$C_{SF,I}$
$S_{dl,u}$
G_i
W_1
W_2
$s_0, s_1, s_2, s_3, \ldots$
$-s_1^*, s_0^*, -s_3^*, s_2^*, \ldots$
Channel Data Symbols
$s_0, s_1, s_2, s_3, \ldots$
Channel Data Symbols
Channel Processor
132a
130a
TMTR
132b
130b
TMTR

FIG. 2

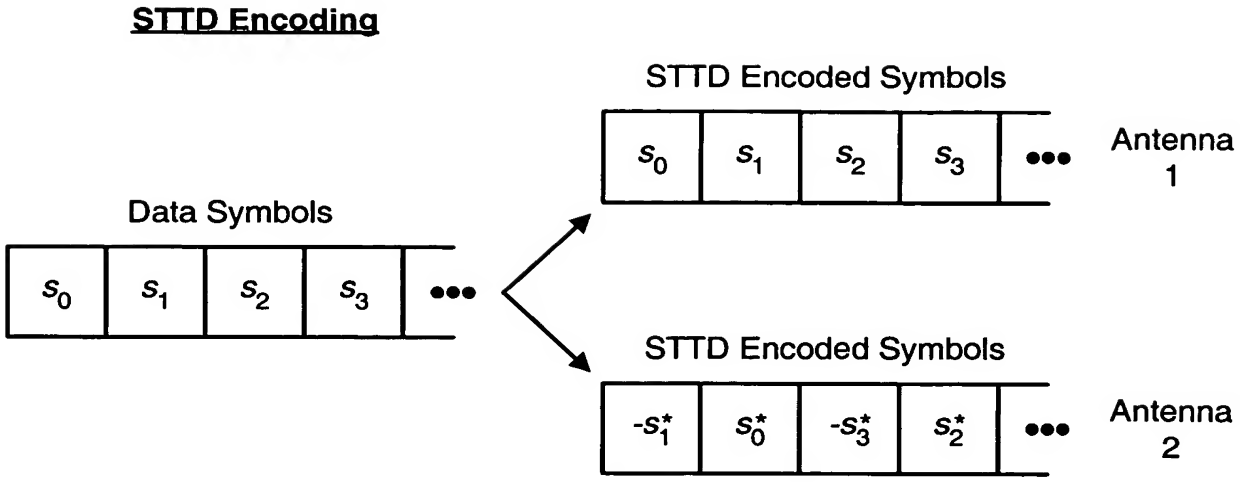
STTD Encoding
STTD Encoded Symbols
s_0 s_1 s_2 s_3 •••
Antenna 1
Data Symbols
s_0 s_1 s_2 s_3 •••
STTD Encoded Symbols
$-s_1^*$ s_0^* $-s_3^*$ s_2^* •••
Antenna 2

FIG. 3

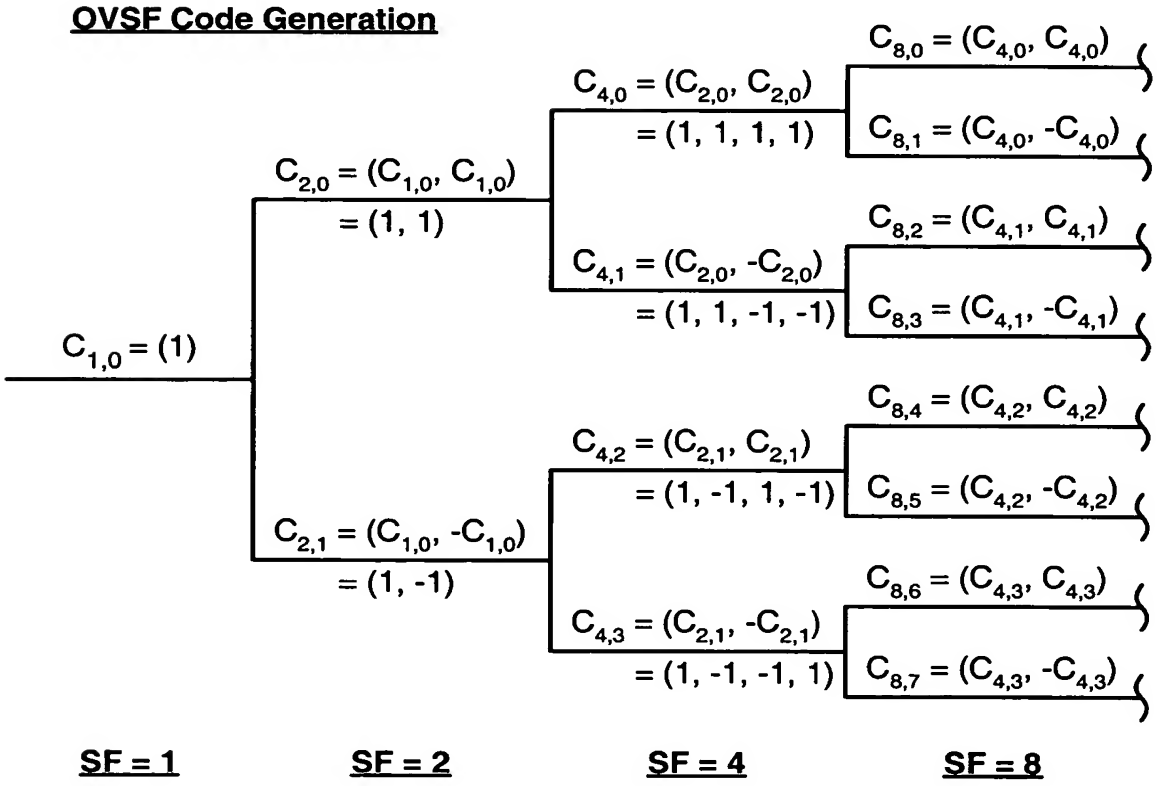
OVSF Code Generation
$C_{1,0} = (1)$
$C_{2,0} = (C_{1,0}, C_{1,0})$ $= (1, 1)$
$C_{2,1} = (C_{1,0}, -C_{1,0})$ $= (1, -1)$
$C_{4,0} = (C_{2,0}, C_{2,0})$ $= (1, 1, 1, 1)$
$C_{4,1} = (C_{2,0}, -C_{2,0})$ $= (1, 1, -1, -1)$
$C_{4,2} = (C_{2,1}, C_{2,1})$ $= (1, -1, 1, -1)$
$C_{4,3} = (C_{2,1}, -C_{2,1})$ $= (1, -1, -1, 1)$
$C_{8,0} = (C_{4,0}, C_{4,0})$
$C_{8,1} = (C_{4,0}, -C_{4,0})$
$C_{8,2} = (C_{4,1}, C_{4,1})$
$C_{8,3} = (C_{4,1}, -C_{4,1})$
$C_{8,4} = (C_{4,2}, C_{4,2})$
$C_{8,5} = (C_{4,2}, -C_{4,2})$
$C_{8,6} = (C_{4,3}, C_{4,3})$
$C_{8,7} = (C_{4,3}, -C_{4,3})$
SF = 1
SF = 2
SF = 4
SF = 8

FIG. 4

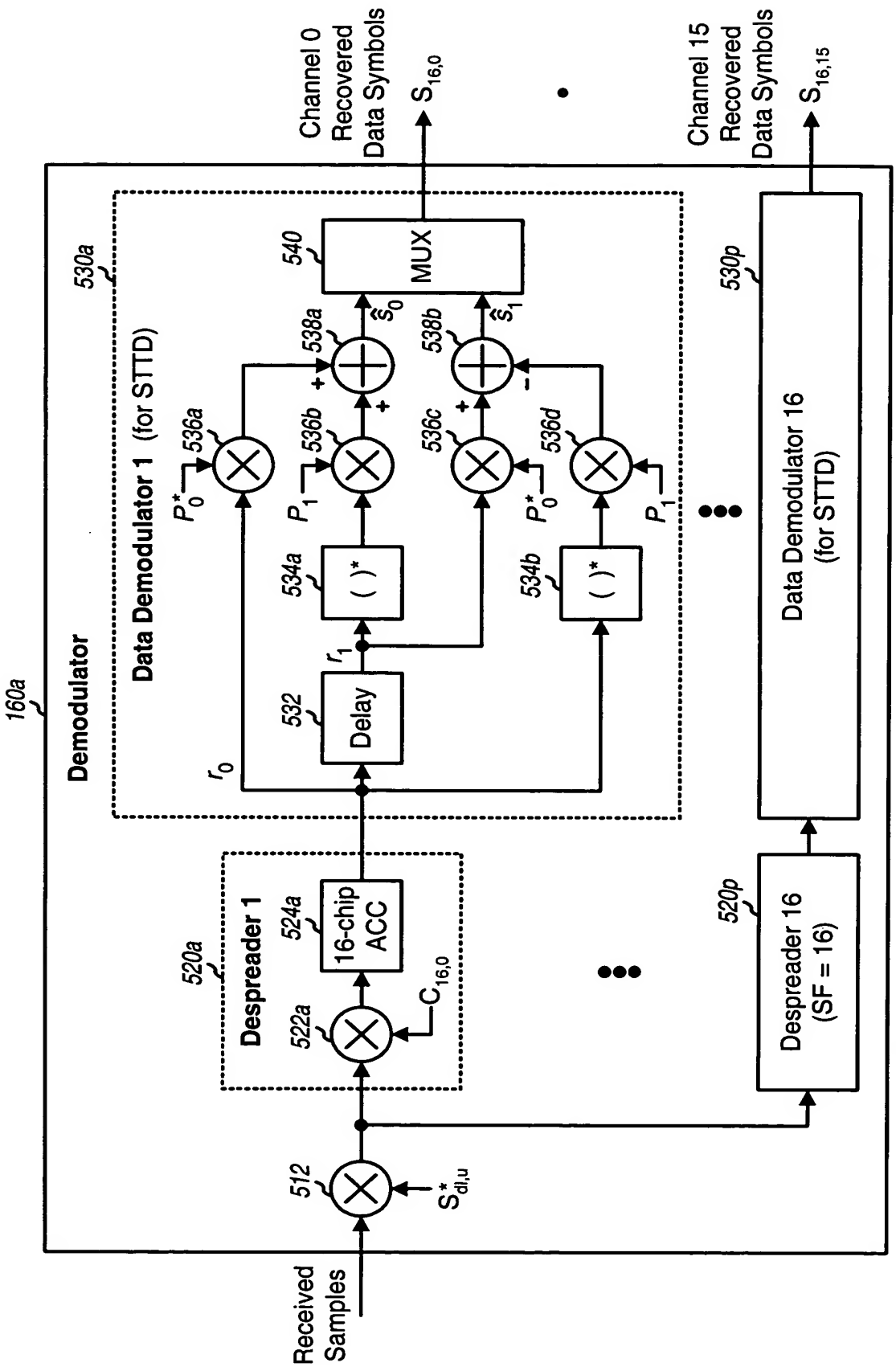
160a
Demodulator
530a
Data Demodulator 1 (for STTD)
Channel 0 Recovered Data Symbols
$S_{16,0}$
Channel 15 Recovered Data Symbols
$S_{16,15}$
540
MUX
538a
538b
536a
536b
536c
536d
534a
534b
( )*
532
Delay
r_0
r_1
P_0^*
P_1
520a
Despreader 1
524a
16-chip ACC
522a
$C_{16,0}$
512
$S^*_{dl,u}$
Received Samples
530p
Data Demodulator 16 (for STTD)
520p
Despreader 16 (SF = 16)

FIG. 5

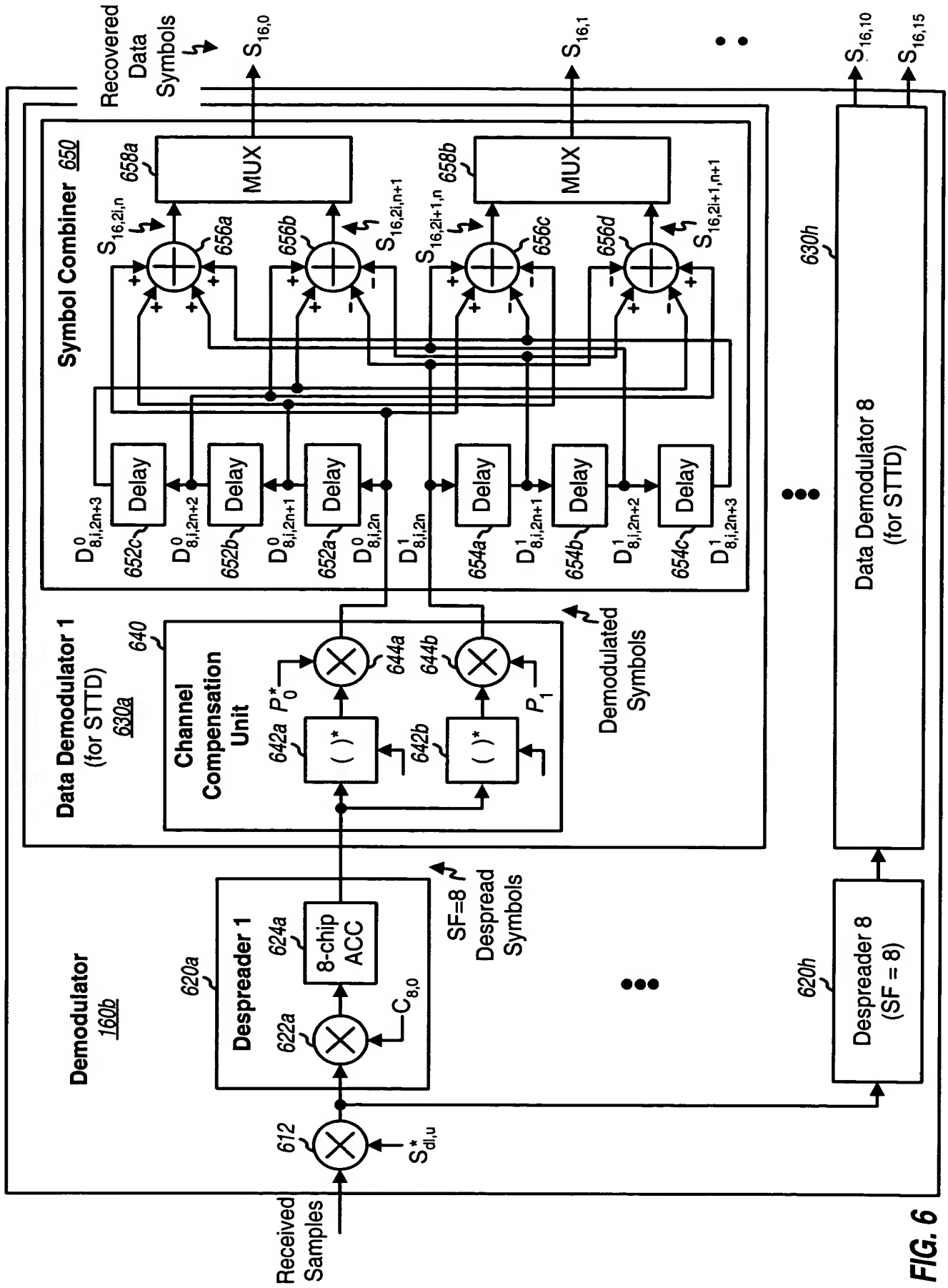
Recovered Data Symbols
$S_{16,0}$
$S_{16,1}$
$S_{16,10}$
$S_{16,15}$
Symbol Combiner 650
658a
658b
MUX
MUX
656a
656b
656c
656d
$S_{16,2i,n}$
$S_{16,2i,n+1}$
$S_{16,2i+1,n}$
$S_{16,2i+1,n+1}$
Delay
652a
652b
652c
654a
654b
654c
$D^0_{8,i,2n}$
$D^0_{8,i,2n+1}$
$D^0_{8,i,2n+2}$
$D^0_{8,i,2n+3}$
$D^1_{8,i,2n}$
$D^1_{8,i,2n+1}$
$D^1_{8,i,2n+2}$
$D^1_{8,i,2n+3}$
Data Demodulator 1 (for STTD) 630a
640
Channel Compensation Unit
642a
642b
644a
644b
P^*_0
P_1
( )*
Demodulated Symbols
630h
Data Demodulator 8 (for STTD)
Demodulator 160b
620a
Despreader 1
622a
624a
8-chip ACC
$C_{8,0}$
SF=8 Despread Symbols
620h
Despreader 8 (SF = 8)
612
$S^*_{di,u}$
Received Samples

FIG. 6

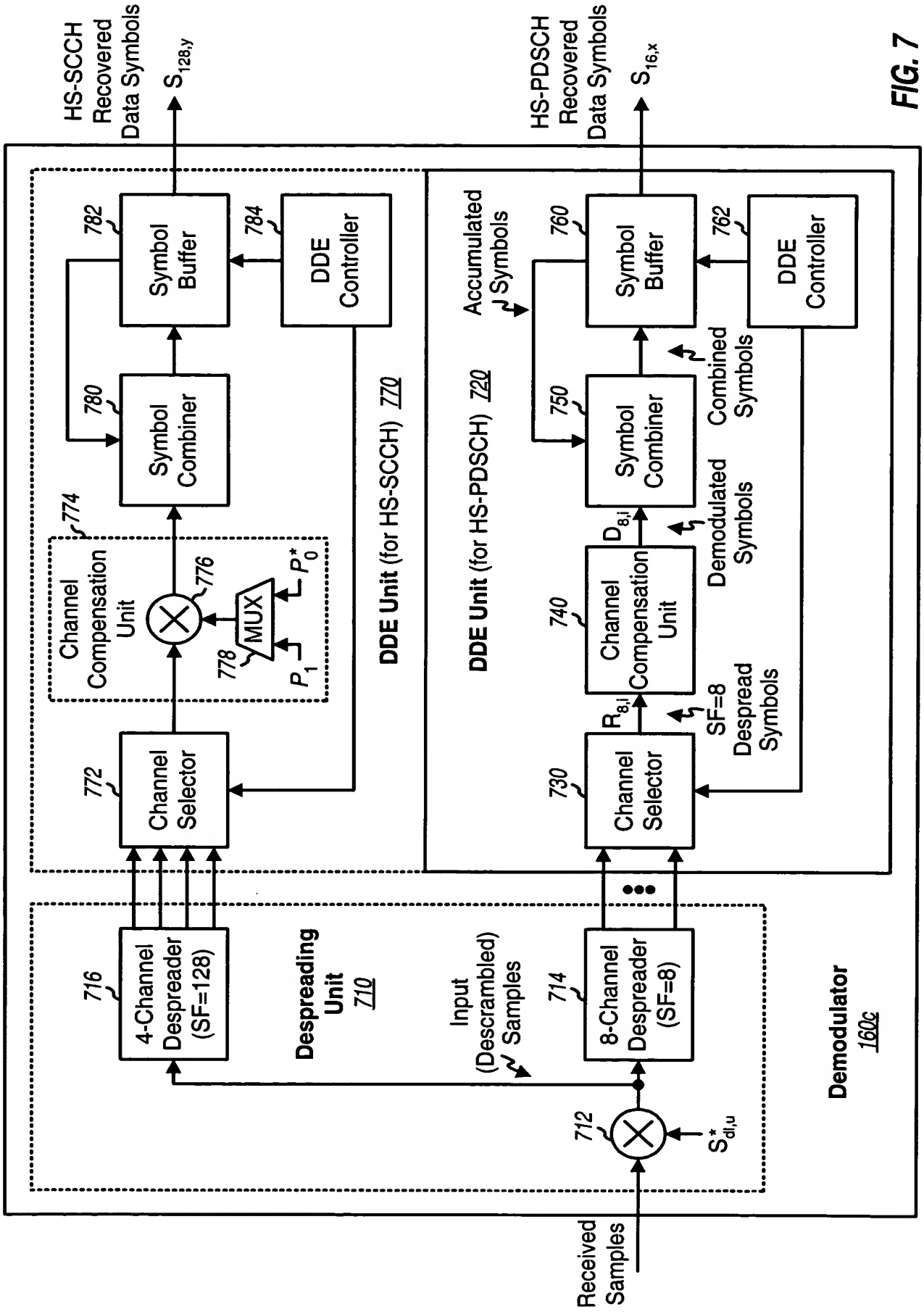
HS-SCCH Recovered Data Symbols
$S_{128,y}$
HS-PDSCH Recovered Data Symbols
$S_{16,x}$
782
Symbol Buffer
784
DDE Controller
780
Symbol Combiner
774
Channel Compensation Unit
776
MUX
778
P_0^*
P_1
772
Channel Selector
DDE Unit (for HS-SCCH) 770
Accumulated Symbols
760
Symbol Buffer
762
DDE Controller
750
Symbol Combiner
Combined Symbols
$D_{8,i}$
Demodulated Symbols
740
Channel Compensation Unit
$R_{8,i}$
SF=8 Despread Symbols
730
Channel Selector
DDE Unit (for HS-PDSCH) 720
716
4-Channel Despreader (SF=128)
Despreading Unit 710
Input (Descrambled) Samples
714
8-Channel Despreader (SF=8)
712
$S_{dl,u}^*$
Demodulator 160c
Received Samples

FIG. 7

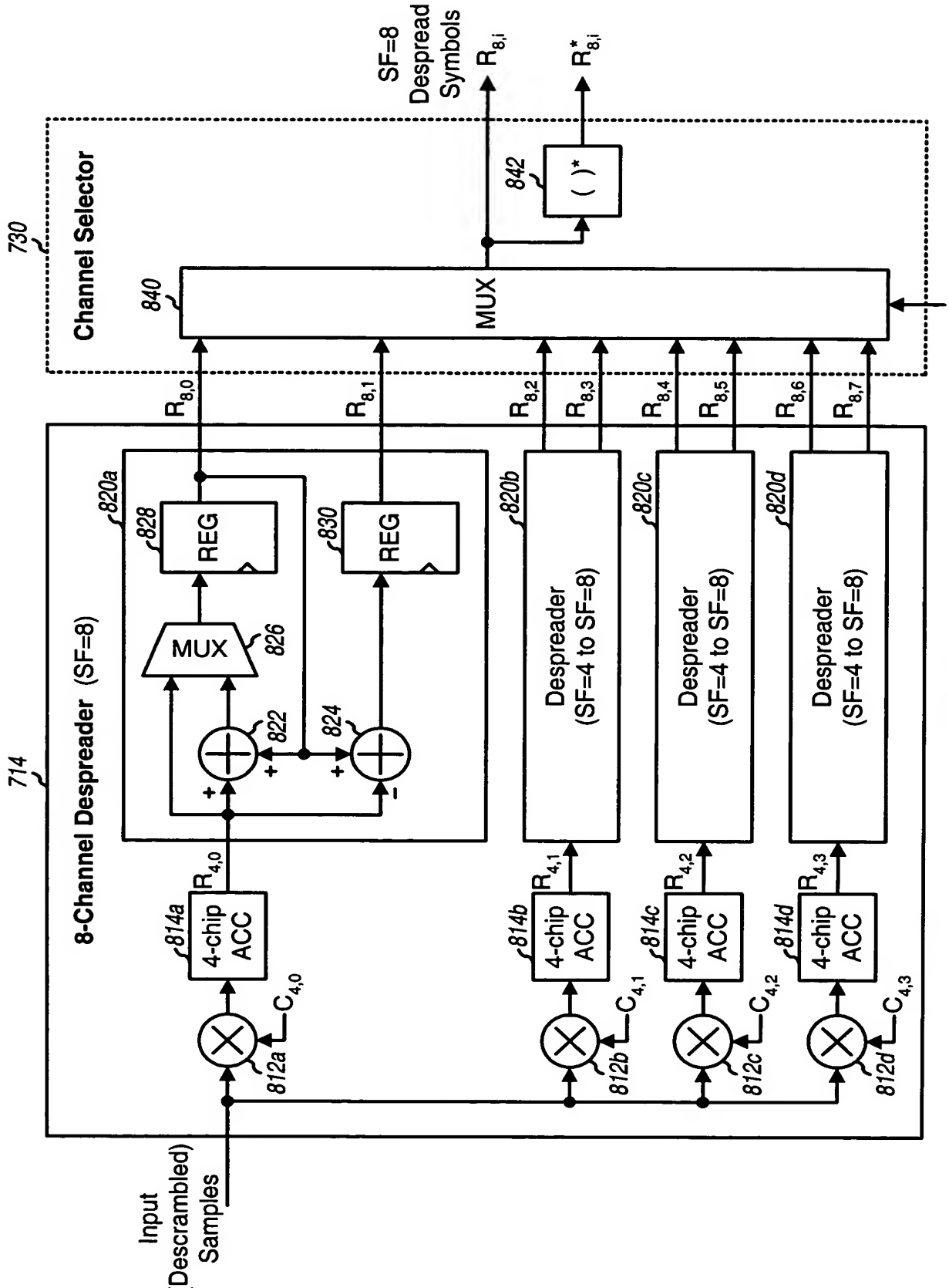
730
Channel Selector
840
MUX
842
( )*
SF=8 Despread Symbols
$R_{8,i}$
$R^*_{8,i}$
714
8-Channel Despreader (SF=8)
820a
828
REG
830
REG
826
MUX
822
824
820b
820c
820d
Despreader (SF=4 to SF=8)
$R_{8,0}$
$R_{8,1}$
$R_{8,2}$
$R_{8,3}$
$R_{8,4}$
$R_{8,5}$
$R_{8,6}$
$R_{8,7}$
$R_{4,0}$
$R_{4,1}$
$R_{4,2}$
$R_{4,3}$
814a
814b
814c
814d
4-chip ACC
$C_{4,0}$
$C_{4,1}$
$C_{4,2}$
$C_{4,3}$
812a
812b
812c
812d
Input (Descrambled) Samples

FIG. 8

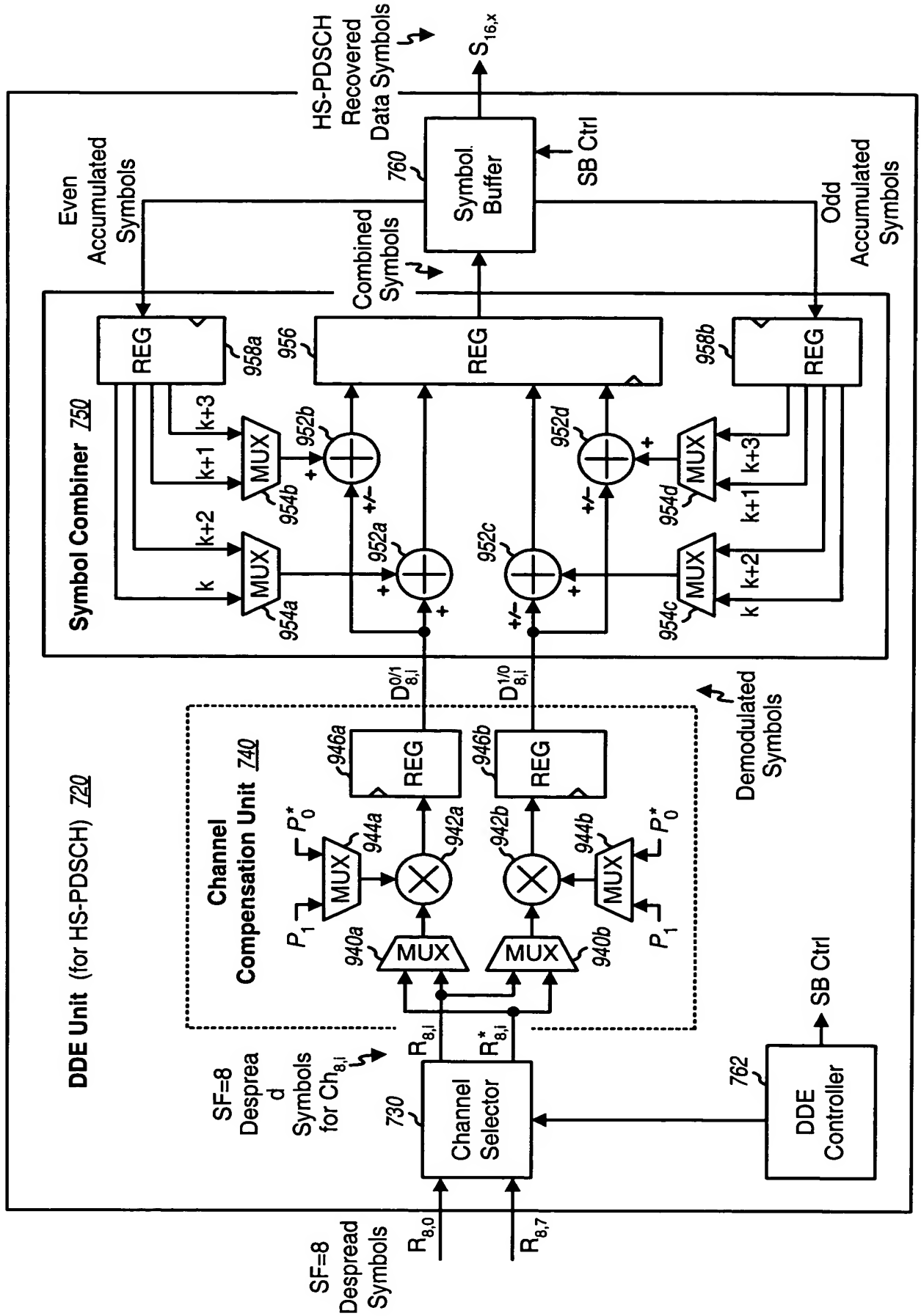
DDE Unit (for HS-PDSCH) 720
SF=8 Despread Symbols
$R_{8,0}$
$R_{8,7}$
Channel Selector 730
SF=8 Despread Symbols for $Ch_{8,i}$
$R_{8,i}$
$R^*_{8,i}$
Channel Compensation Unit 740
MUX 940a
MUX 940b
MUX 942a
MUX 942b
MUX 944a
MUX 944b
P_1
P^*_0
REG 946a
REG 946b
$D^{0/1}_{8,i}$
$D^{1/0}_{8,i}$
Demodulated Symbols
Symbol Combiner 750
REG 956
REG 958a
REG 958b
MUX 954a
MUX 954b
MUX 954c
MUX 954d
k
k+1
k+2
k+3
952a
952b
952c
952d
Even Accumulated Symbols
Odd Accumulated Symbols
Combined Symbols
Symbol Buffer 760
SB Ctrl
HS-PDSCH Recovered Data Symbols
$S_{16,x}$
DDE Controller 762
SB Ctrl

FIG. 9

Symbol period 2n

Cycle 0	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
Retrieve even and odd symbols for $Ch_{16,0}$, $Ch_{16,1}$, $Ch_{16,2}$, and $Ch_{16,3}$ from symbol buffer		Retrieve even and odd symbols for $Ch_{16,4}$, $Ch_{16,5}$, $Ch_{16,6}$, and $Ch_{16,7}$ from symbol buffer		Retrieve even and odd symbols for $Ch_{16,8}$, $Ch_{16,9}$, $Ch_{16,10}$, and $Ch_{16,11}$ from symbol buffer	
Multiply symbol for $Ch_{8,0}$ with P_0 and P_1 and provide symbols $D^0_{8,0}$ and $D^1_{8,0}$	Multiply symbol for $Ch_{8,1}$ with P_0 and P_1 and provide symbols $D^0_{8,1}$ and $D^1_{8,1}$	Multiply symbol for $Ch_{8,2}$ with P_0 and P_1 and provide symbols $D^0_{8,2}$ and $D^1_{8,2}$	Multiply symbol for $Ch_{8,3}$ with P_0 and P_1 and provide symbols $D^0_{8,3}$ and $D^1_{8,3}$	Multiply symbol for $Ch_{8,4}$ with P_0 and P_1 and provide symbols $D^0_{8,4}$ and $D^1_{8,4}$	Multiply symbol for $Ch_{8,5}$ with P_0 and P_1 and provide symbols $D^0_{8,5}$ and $D^1_{8,5}$
	Combine symbols $D^0_{8,0}$ and $D^1_{8,0}$ with even and odd symbols for $Ch_{16,0}$ and $Ch_{16,1}$	Combine symbols $D^0_{8,1}$ and $D^1_{8,1}$ with even and odd symbols for $Ch_{16,2}$ and $Ch_{16,3}$	Combine symbols $D^0_{8,2}$ and $D^1_{8,2}$ with even and odd symbols for $Ch_{16,4}$ and $Ch_{16,5}$	Combine symbols $D^0_{8,3}$ and $D^1_{8,3}$ with even and odd symbols for $Ch_{16,6}$ and $Ch_{16,7}$	Combine symbols $D^0_{8,4}$ and $D^1_{8,4}$ with even and odd symbols for $Ch_{16,8}$ and $Ch_{16,9}$
			Store combined symbols for $Ch_{16,0}$, $Ch_{16,1}$, $Ch_{16,2}$, and $Ch_{16,3}$ back to symbol buffer		Store combined symbols for $Ch_{16,4}$, $Ch_{16,5}$, $Ch_{16,6}$, and $Ch_{16,7}$ back to symbol buffer

to FIG. 10B

FIG. 10A

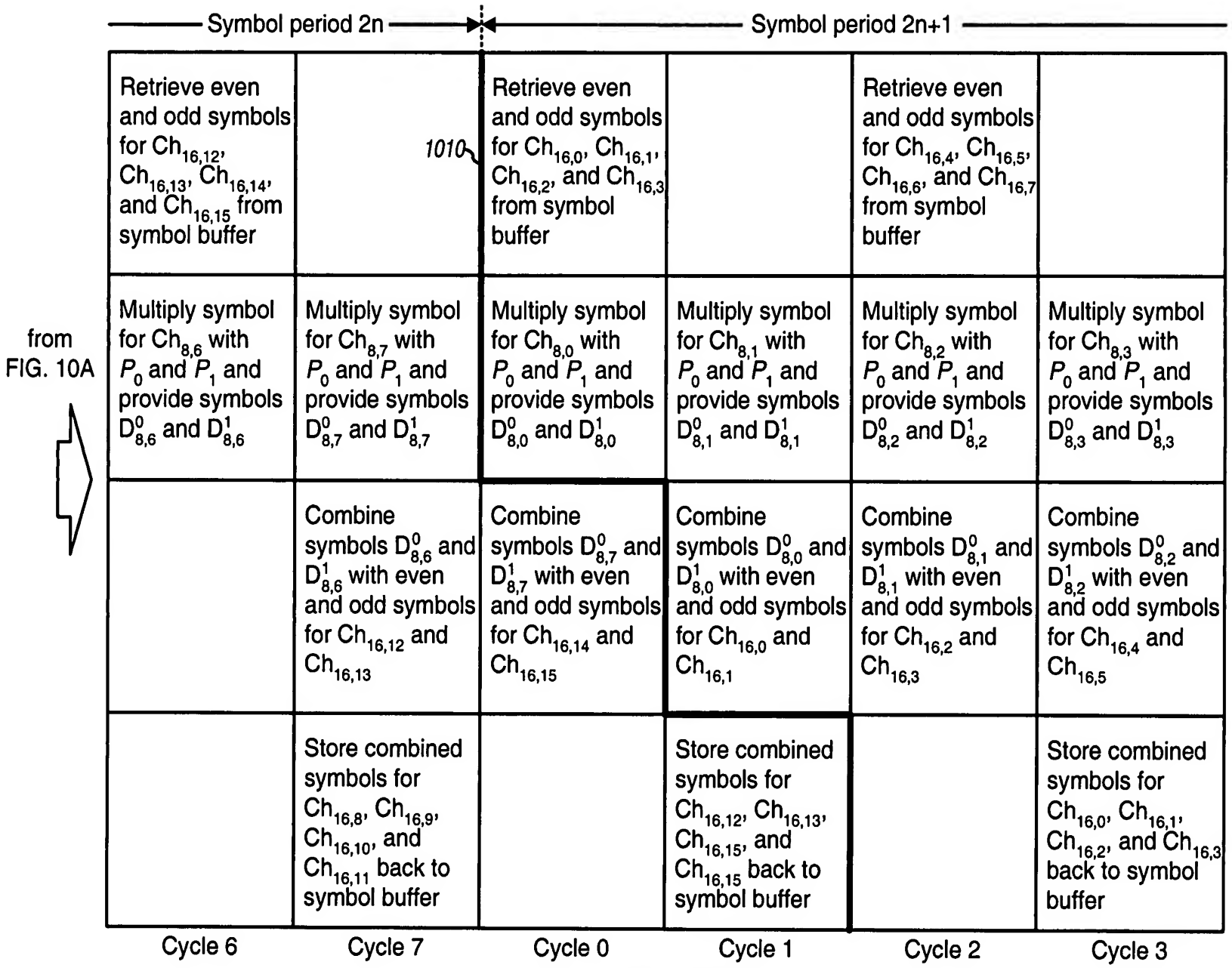
Symbol period 2n
Symbol period 2n+1
from FIG. 10A
1010
Retrieve even and odd symbols for $Ch_{16,12}$, $Ch_{16,13}$, $Ch_{16,14}$, and $Ch_{16,15}$ from symbol buffer
Retrieve even and odd symbols for $Ch_{16,0}$, $Ch_{16,1}$, $Ch_{16,2}$, and $Ch_{16,3}$ from symbol buffer
Retrieve even and odd symbols for $Ch_{16,4}$, $Ch_{16,5}$, $Ch_{16,6}$, and $Ch_{16,7}$ from symbol buffer
Multiply symbol for $Ch_{8,6}$ with P_0 and P_1 and provide symbols $D^0_{8,6}$ and $D^1_{8,6}$
Multiply symbol for $Ch_{8,7}$ with P_0 and P_1 and provide symbols $D^0_{8,7}$ and $D^1_{8,7}$
Multiply symbol for $Ch_{8,0}$ with P_0 and P_1 and provide symbols $D^0_{8,0}$ and $D^1_{8,0}$
Multiply symbol for $Ch_{8,1}$ with P_0 and P_1 and provide symbols $D^0_{8,1}$ and $D^1_{8,1}$
Multiply symbol for $Ch_{8,2}$ with P_0 and P_1 and provide symbols $D^0_{8,2}$ and $D^1_{8,2}$
Multiply symbol for $Ch_{8,3}$ with P_0 and P_1 and provide symbols $D^0_{8,3}$ and $D^1_{8,3}$
Combine symbols $D^0_{8,6}$ and $D^1_{8,6}$ with even and odd symbols for $Ch_{16,12}$ and $Ch_{16,13}$
Combine symbols $D^0_{8,7}$ and $D^1_{8,7}$ with even and odd symbols for $Ch_{16,14}$ and $Ch_{16,15}$
Combine symbols $D^0_{8,0}$ and $D^1_{8,0}$ with even and odd symbols for $Ch_{16,0}$ and $Ch_{16,1}$
Combine symbols $D^0_{8,1}$ and $D^1_{8,1}$ with even and odd symbols for $Ch_{16,2}$ and $Ch_{16,3}$
Combine symbols $D^0_{8,2}$ and $D^1_{8,2}$ with even and odd symbols for $Ch_{16,4}$ and $Ch_{16,5}$
Store combined symbols for $Ch_{16,8}$, $Ch_{16,9}$, $Ch_{16,10}$, and $Ch_{16,11}$ back to symbol buffer
Store combined symbols for $Ch_{16,12}$, $Ch_{16,13}$, $Ch_{16,15}$, and $Ch_{16,15}$ back to symbol buffer
Store combined symbols for $Ch_{16,0}$, $Ch_{16,1}$, $Ch_{16,2}$, and $Ch_{16,3}$ back to symbol buffer
Cycle 6
Cycle 7
Cycle 0
Cycle 1
Cycle 2
Cycle 3

FIG. 10B

760

Memory Bank 1 (SF=16 Channels 0, 1, 2, 3, 8, 9, 10, 11) *1110a*

0	$S_{16,0,0}$	$S_{16,0,1}$	$S_{16,1,0}$	$S_{16,1,1}$	$S_{16,2,0}$	$S_{16,2,1}$	$S_{16,3,0}$	$S_{16,3,1}$
1	$S_{16,0,2}$	$S_{16,0,3}$	$S_{16,1,2}$	$S_{16,1,3}$	$S_{16,2,2}$	$S_{16,2,3}$	$S_{16,3,2}$	$S_{16,3,3}$
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
79	$S_{16,0,158}$	$S_{16,0,159}$	$S_{16,1,158}$	$S_{16,1,159}$	$S_{16,2,158}$	$S_{16,2,159}$	$S_{16,3,158}$	$S_{16,3,159}$
80	$S_{16,8,0}$	$S_{16,8,1}$	$S_{16,9,0}$	$S_{16,9,1}$	$S_{16,10,0}$	$S_{16,10,1}$	$S_{16,11,0}$	$S_{16,11,1}$
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
159	$S_{16,8,158}$	$S_{16,8,159}$	$S_{16,9,158}$	$S_{16,9,159}$	$S_{16,10,158}$	$S_{16,10,159}$	$S_{16,11,158}$	$S_{16,11,159}$

Memory Bank 2 (SF=16 Channels 4, 5, 6, 7, 12, 13, 14, 15) *1110a*

0	$S_{16,4,0}$	$S_{16,4,1}$	$S_{16,5,0}$	$S_{16,5,1}$	$S_{16,6,0}$	$S_{16,6,1}$	$S_{16,7,0}$	$S_{16,7,1}$
1	$S_{16,4,2}$	$S_{16,4,3}$	$S_{16,5,2}$	$S_{16,5,3}$	$S_{16,6,2}$	$S_{16,6,3}$	$S_{16,7,2}$	$S_{16,7,3}$
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
79	$S_{16,4,158}$	$S_{16,4,159}$	$S_{16,5,158}$	$S_{16,5,159}$	$S_{16,6,158}$	$S_{16,6,159}$	$S_{16,7,158}$	$S_{16,7,159}$
80	$S_{16,12,0}$	$S_{16,12,1}$	$S_{16,13,0}$	$S_{16,13,1}$	$S_{16,14,0}$	$S_{16,14,1}$	$S_{16,15,0}$	$S_{16,15,1}$
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
159	$S_{16,12,158}$	$S_{16,12,159}$	$S_{16,13,158}$	$S_{16,13,159}$	$S_{16,14,158}$	$S_{16,14,159}$	$S_{16,15,158}$	$S_{16,15,159}$

FIG. 11

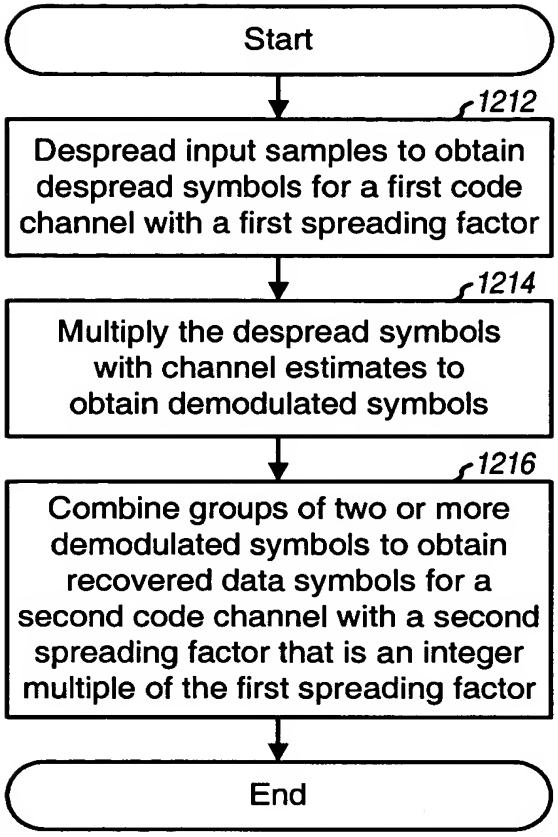
Start
1200
1212
Despread input samples to obtain despread symbols for a first code channel with a first spreading factor
1214
Multiply the despread symbols with channel estimates to obtain demodulated symbols
1216
Combine groups of two or more demodulated symbols to obtain recovered data symbols for a second code channel with a second spreading factor that is an integer multiple of the first spreading factor
End

FIG. 12